

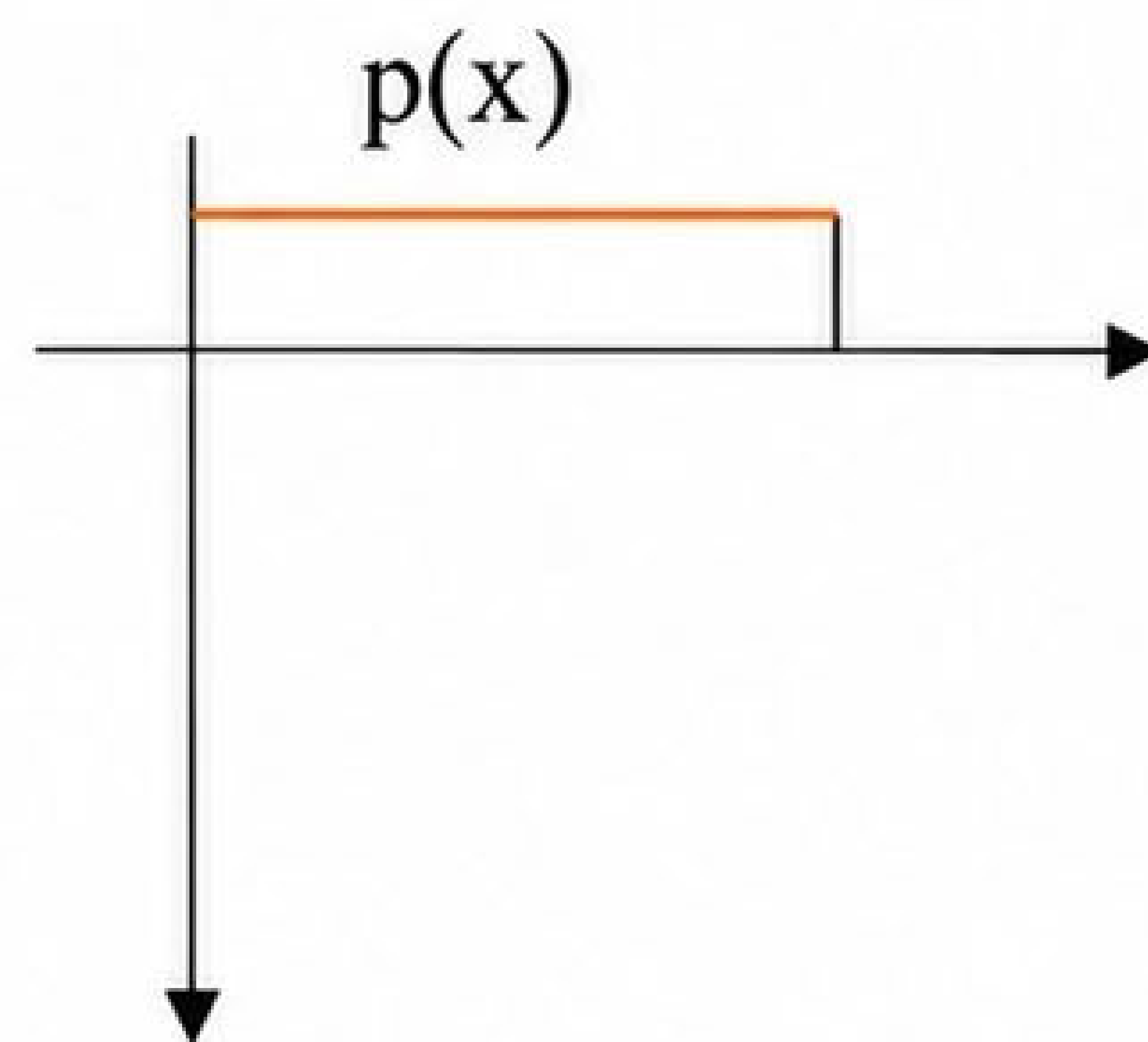
INTERNAL FORCE DIAGRAMS

Key points:

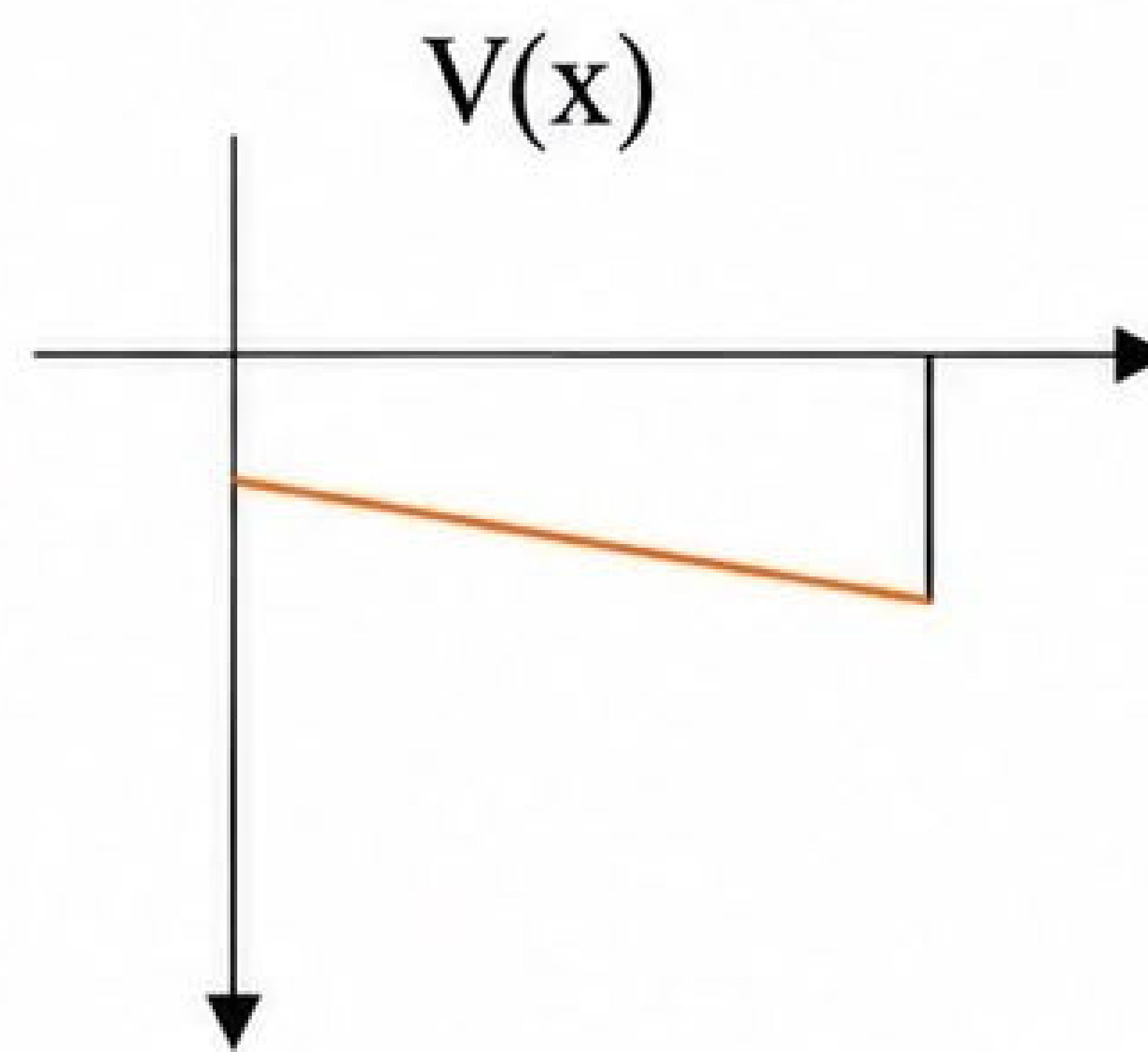
supports, concentrated forces, endpoints of distributed loads, geometric changes (member branching, kink)

Relationships between the load function and the internal force functions:

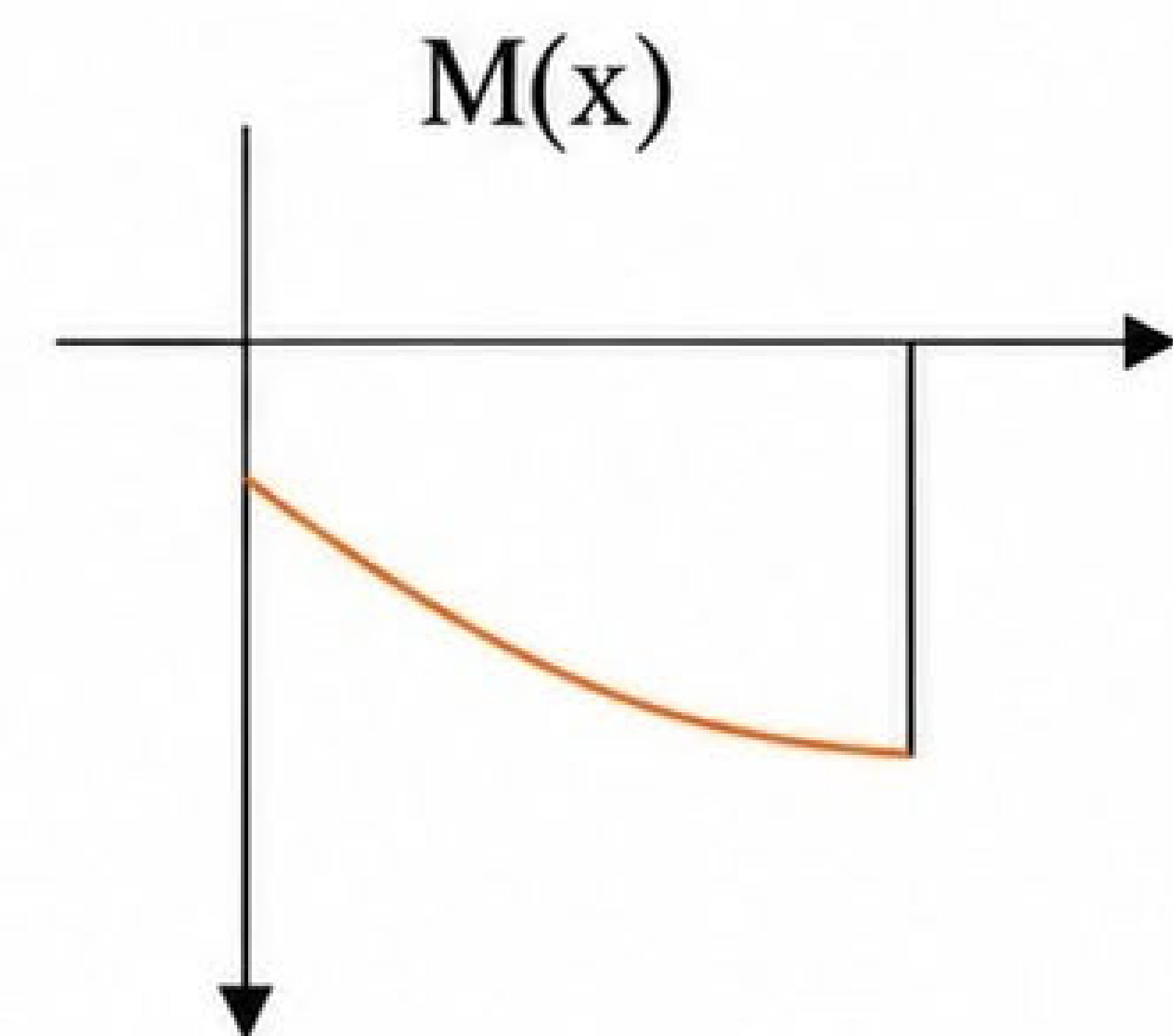
$p(x) = -V'(x)$	0	constant	linear	concentrated force	concentrated moment
$V(x) = M'(x)$	constant	linear	2nd order	jump	—
$M(x)$	linear	2nd order	3rd order	kink	jump



$$p(x) = \text{constant}$$
$$p(x) = -V'(x)$$



$$V(x) = \text{linear}$$
$$V(x) = M'(x)$$

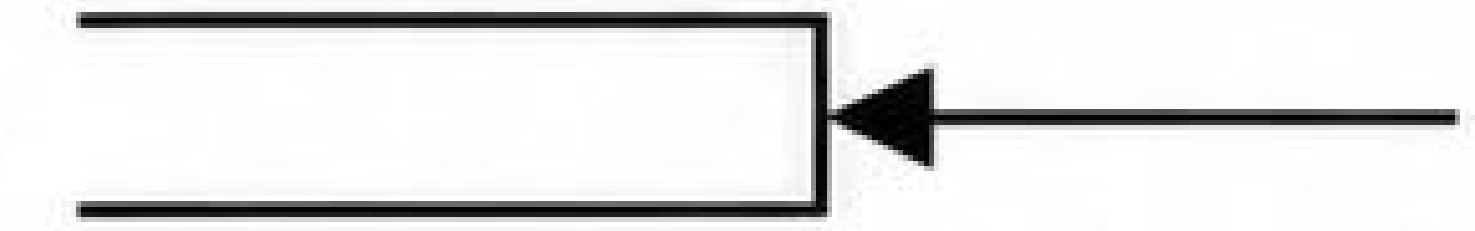
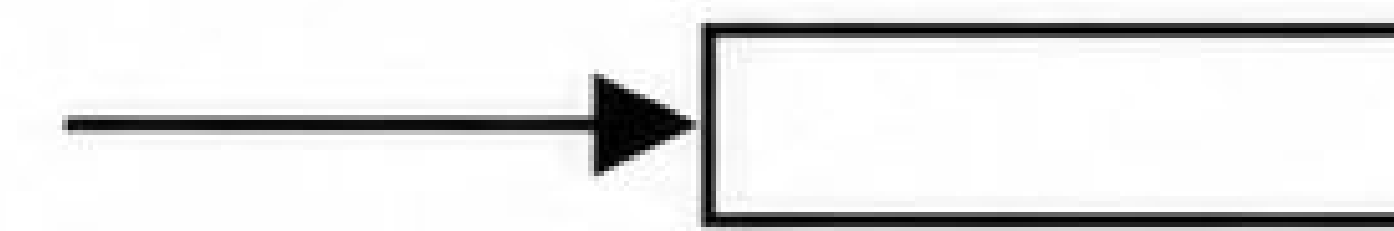


$$M(x) = \text{2nd order parabolic}$$

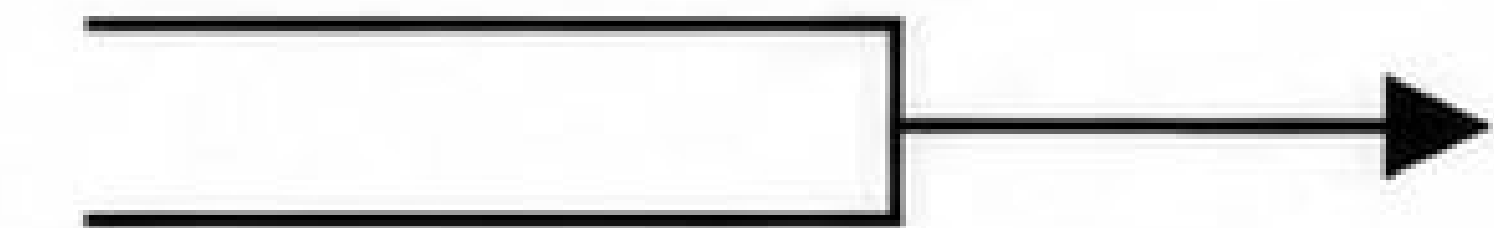
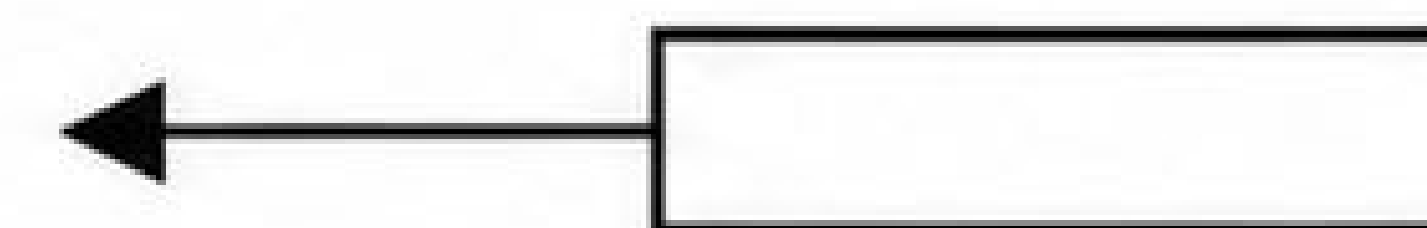
Sign conventions:

N (axial force):

- Compression

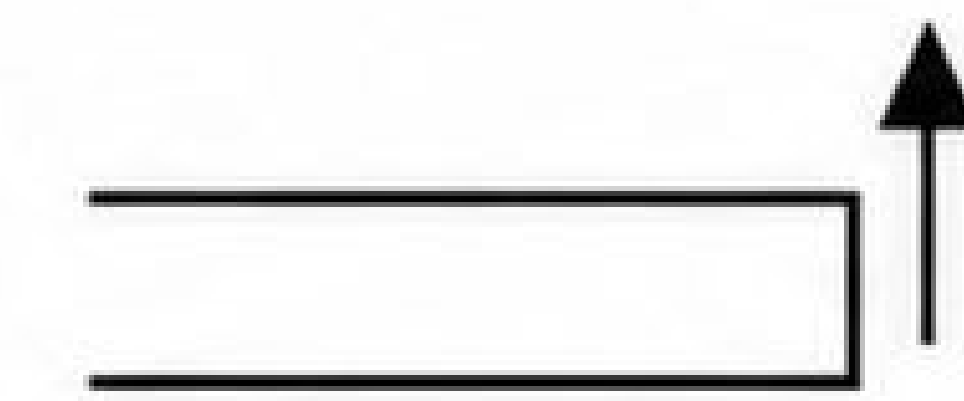
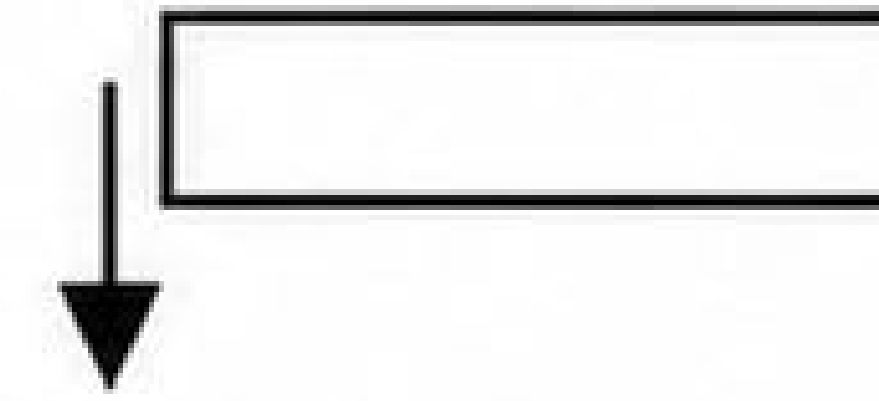


+ Tension

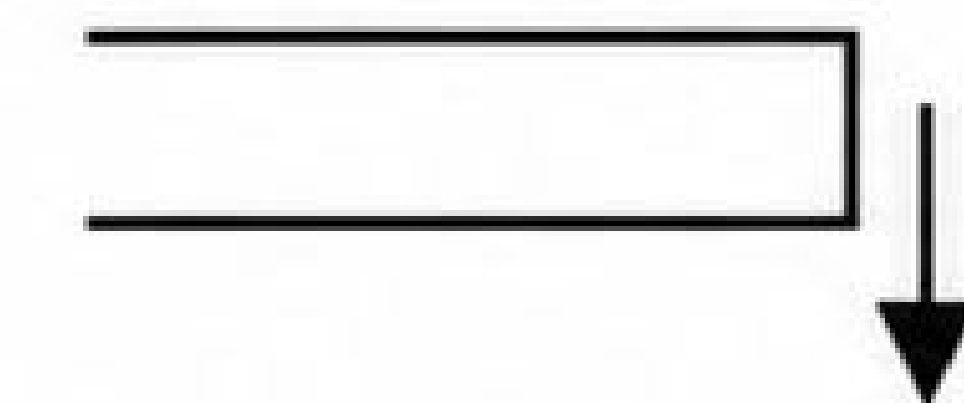
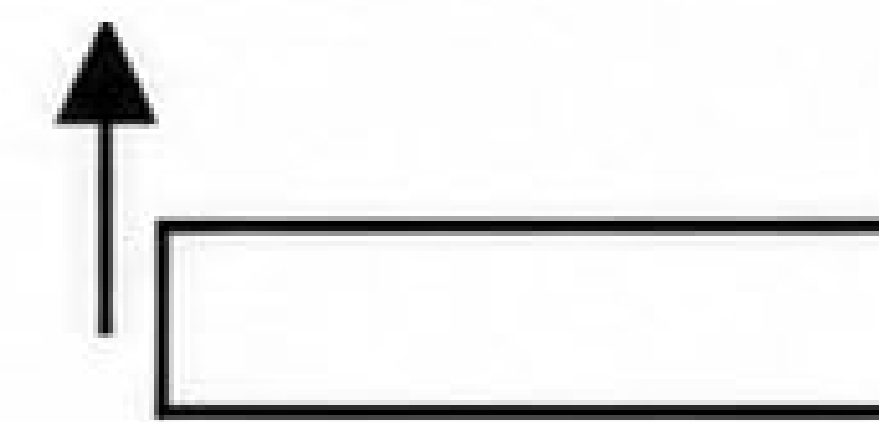


V (shear force):

-



+



M (bending moment):

The moment always acts on the **TENSIONED** side.

	TYPE OF LOADING ON THE BEAM OR THE INVESTIGATED BEAM SECTION	SHEAR FORCE DIAGRAM (V)	BENDING MOMENT DIAGRAM (M)
1		depends on the coordinate system orientation	always on the tensioned side
2	hinge	no special feature	zero
3	concentrated external force	jump (discontinuity)	kink (change in slope)
4	concentrated moment	no special feature	jump (discontinuity)
5	no load, uniform beam with constant cross-section	constant	linear
6	uniformly distributed load, uniform cross-section	linear	second- order parabola
7	load-free, free end of the beam	zero	zero
8	At locations where the shear force diagram change s sign the bending moment diagram has a peak (minimum or maximum)		

Characteristics of the shear force and bending moment diagrams
(bending of a straight beam). Load is perpendicular to the axes of the beam.

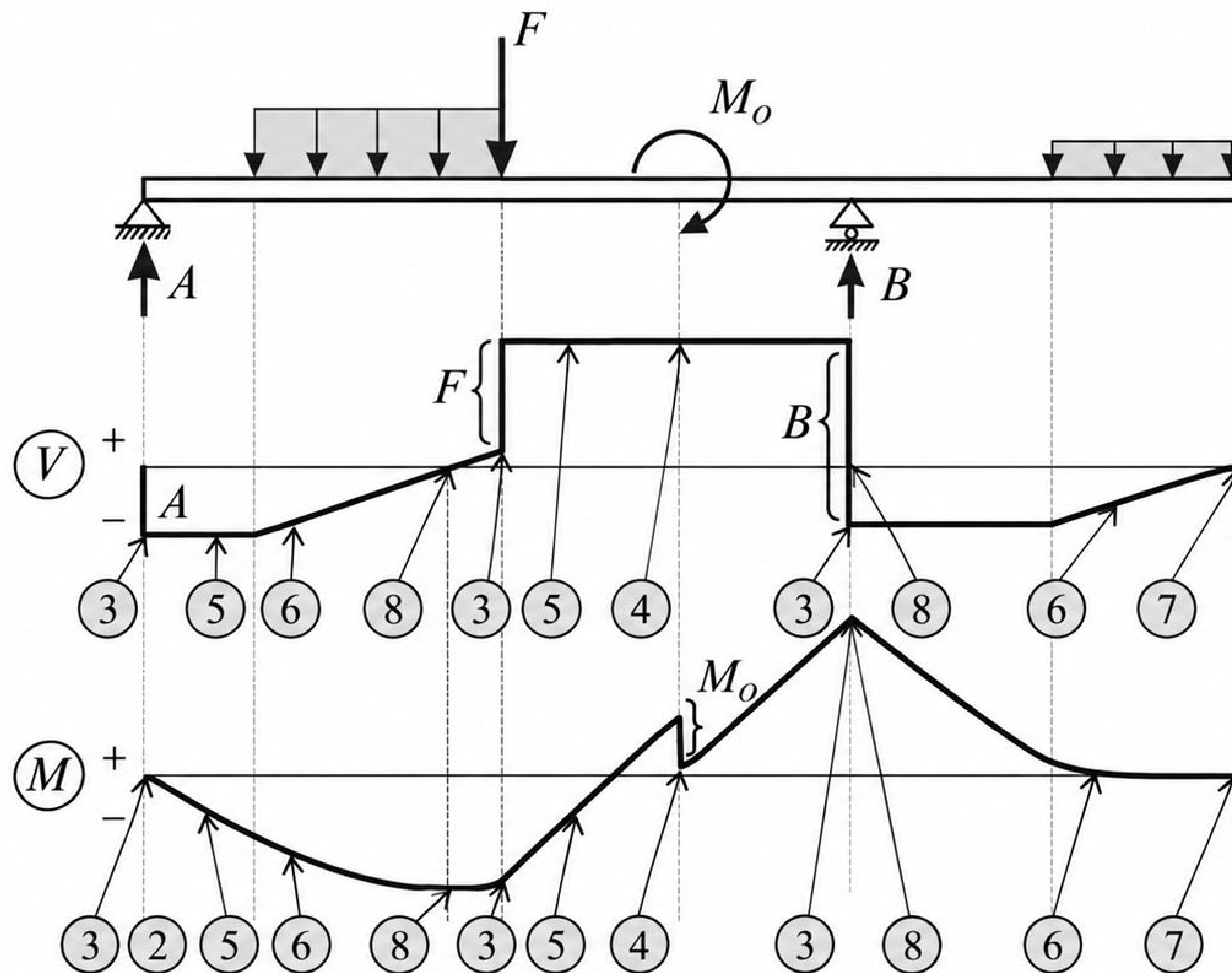


Illustration of the rules summarized in **Table** The numbered arrows refer to the rules listed in the table. In the bending moment diagram, a kink occurs only at the two concentrated external forces. (The lines of the bending moment diagram are parallel in the two regions of constant moment.)